

Fig.1

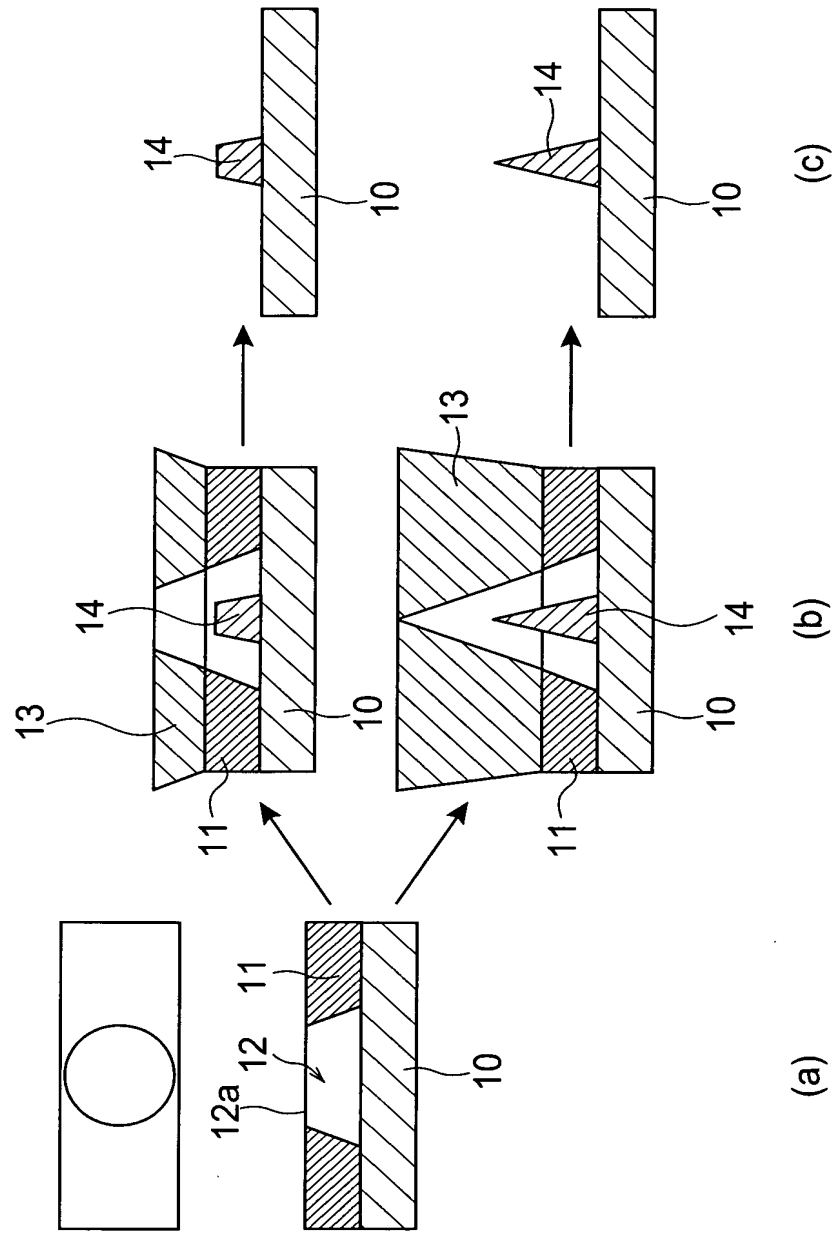
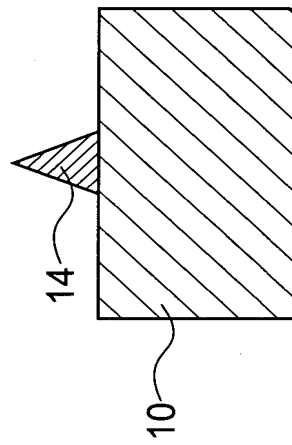
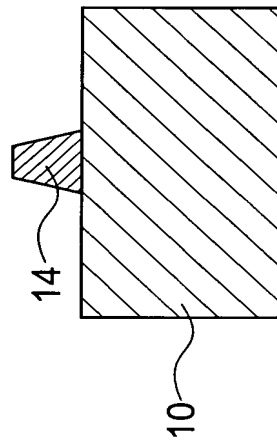
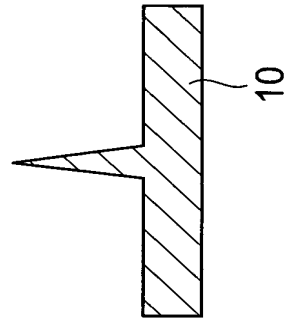
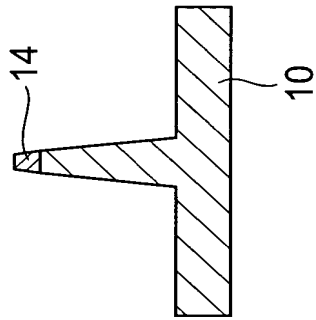


Fig.2



(a)



(b)

Fig.3

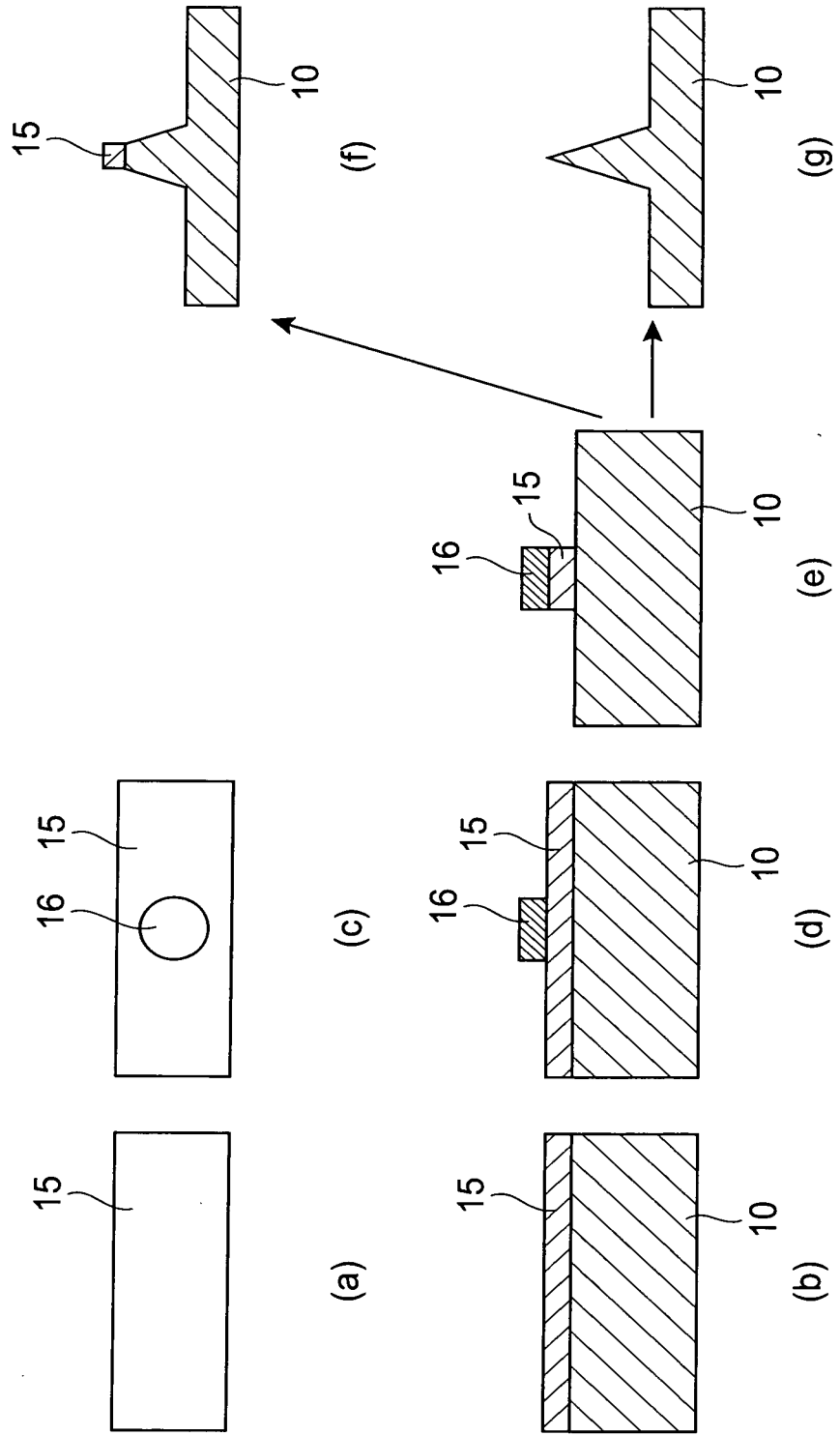


Fig.4

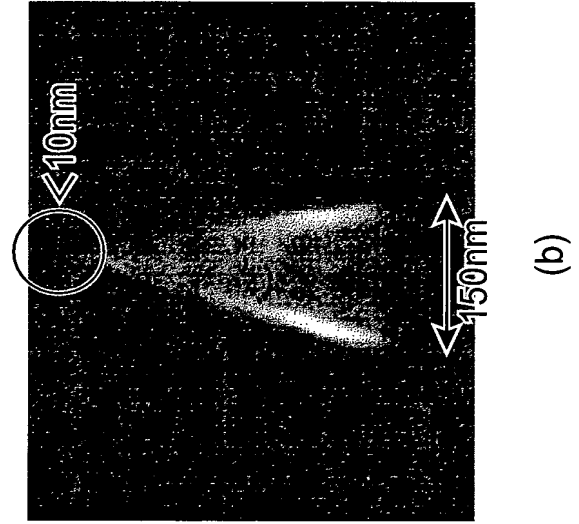
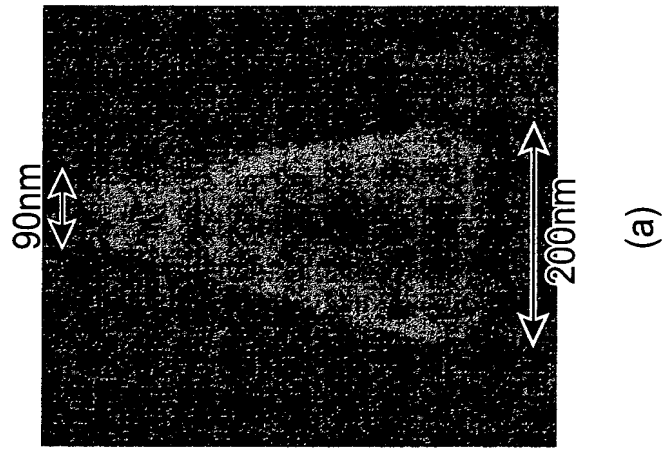


Fig.5


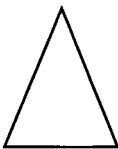

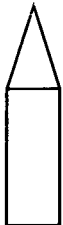
	Au	Mo	Pt	Al
PROJECTION SHAPE				
TIP ANGLE (DEGREE)	30	40	15	10
ASPECT RATIO	4	2.5	4	5

Fig.6

	METHOD OF PREPARING SAMPLE	THRESHOLD VOLTAGE OF PLATE SAMPLE	THRESHOLD VOLTAGE OF PROJECTION SAMPLE
(A)	N ION IMPLANTATION TO DIAMOND ($150\text{keV} \cdot 10^{15}\text{cm}^{-2}$) SAMPLE	> 3kV	1000V
(B)	Ar ION IMPLANTATION TO DIAMOND ($150\text{keV} \cdot 10^{15}\text{cm}^{-2}$) SAMPLE	> 3kV	1100V
(C)	VACUUM ANNEAL AT 1500°C AFTER Ar ION IMPLANTATION TO DIAMOND ($150\text{keV} \cdot 10^{15}\text{cm}^{-2}$) SAMPLE	> 3kV	800V
(D)	VACUUM ANNEAL OF DIAMOND AT 1500°C	> 3kV	1000V
(E)	VACUUM ANNEAL OF DIAMOND AT 1800°C	> 3kV	900V
(F)	VACUUM ANNEAL OF SiC AT 1800°C	> 3kV	1000V
(G)	VACUUM ANNEAL AT 1800°C AFTER Ar ION IMPLANTATION TO SiC ($150\text{keV} \cdot 10^{15}\text{cm}^{-2}$) SAMPLE	> 3kV	900V
(H)	VACUUM ANNEAL AT 1500°C AFTER Ar ION IMPLANTATION TO DIAMOND ($150\text{keV} \cdot 10^{15}\text{cm}^{-2}$) SAMPLE	> 3kV	800V

Fig.7



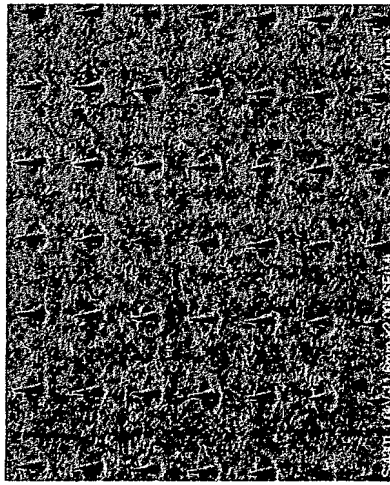
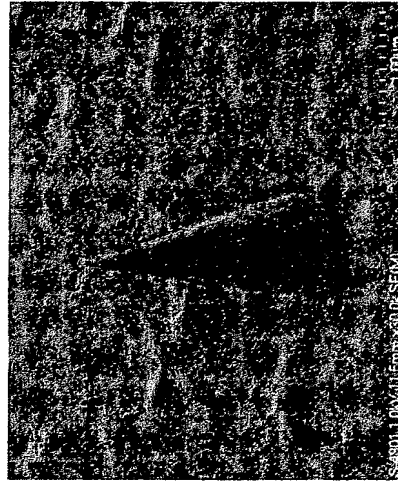
	SiOx X=1.5	SiOx X=1.9
DIAMOND PROJECTION SHAPE		
TIP ANGLE (DEGREE)	20	10
ASPECT RATIO	2.0	4

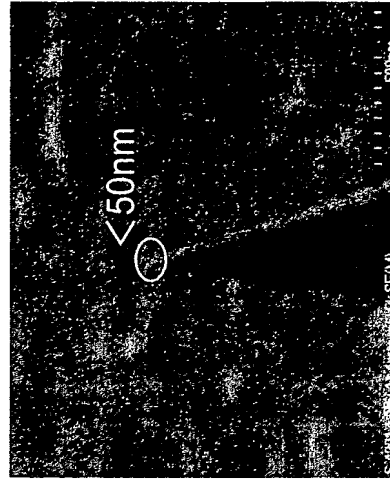
Fig.8



(a)



(b)



(c)

Fig.9

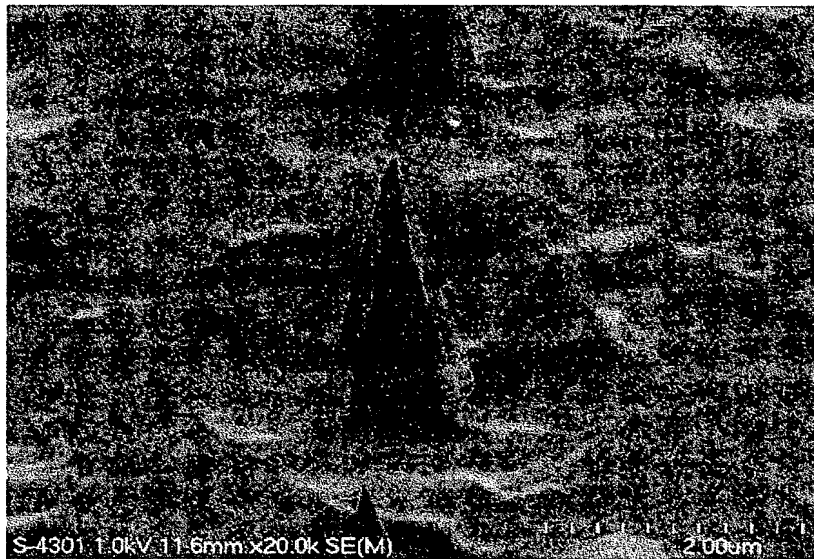


Fig.10

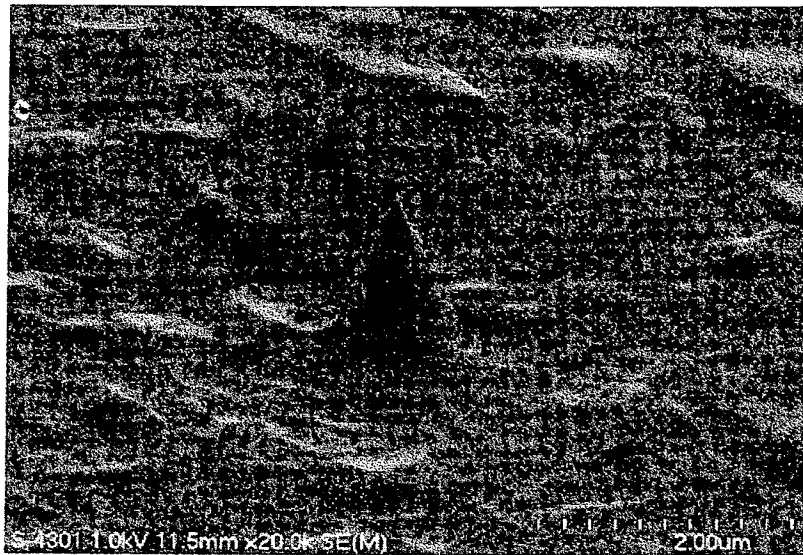


Fig.11

	MATERIAL OF MASK (FORMED BY CVD)	PROJECTION SIZE	TIP DIAMETER OF PROJECTION	APEX ANGLE	UNIFORMITY	CURRENT DENSITY OF PROJECTION SAMPLE	EMITTER DENSITY
DIAMOND							
(J)	SiN _{1.3}	300nm	~30 nm	32	2%	130mA/mm ²	4 EMITTER / m ²
(K)	SiN _{0.5}	800nm	~40 nm	30	3%	20mA/mm ²	0.6 EMITTER / m ²
(L)	SiN _{0.5}	300nm	~40 nm	30	3%	130mA/mm ²	4 EMITTER / m ²
(M)	SiO _{0.5} N _{0.6}	300nm	~30 nm	25	5%	150mA/mm ²	4 EMITTER / m ²
(N)	SiO _{1.3} N _{0.3}	300nm	~30 nm	28	4%	140mA/mm ²	4 EMITTER / m ²
(O)	SiO _{0.2} N _{0.6}	300nm	~30 nm	28	4%	130mA/mm ²	4 EMITTER / m ²
(P)	SiO _{1.3} N _{0.1}	800nm	~40 nm	30	3%	30mA/mm ²	0.6 EMITTER / m ²
(Q)	SiO _{1.3} N _{0.1}	300nm	~30 nm	30	3%	130mA/mm ²	4 EMITTER / m ²
(R)	SiO _{1.9} N _{0.05}	800nm	~50 nm	39	5%	15mA/mm ²	0.6 EMITTER / m ²
(S)	SiO ₂	800nm	~80 nm	44	10%	5mA/mm ²	0.6 EMITTER / m ²
(T)	SiO ₂	300nm	IMPOSSIBLE TO FORM	—	—	—	4 EMITTER / m ²
CNT/SiC							
(U)	SiO _{1.3} N _{0.1}	300nm	<40nm	25	5%	100mA/mm ²	4 EMITTER / m ²

Fig.12

ETCHING CONDITION	O ₂ GAS	CF ₄ GAS	Ar GAS	POWER (W)	PRESSURE (Pa)
(1)	98%	2%	0%	200	2
(2)	98%	2%	0%	50	2
(3)	90%	10%	0%	200	20
(4)	49%	1%	50%	200	2

Fig.13

MATERIALS	MATERIAL OF MASK (FORMED BY CVD)	ETCHING CONDITION	TIP DIAMETER	APEX ANGLE	UNIFORMITY	CURRENT DENSITY OF EMITTER
DIAMOND	SiN _{1.3}	(1)	~30 nm	32	±2%	130mA/mm ²
DIAMOND	SiN _{1.3}	(2)	~30 nm	20	±4%	170mA/mm ²
DIAMOND	SiN _{1.3}	(3)	~40 nm	39	±3%	100mA/mm ²
DIAMOND	SiN _{1.3}	(4)	~40 nm	35	±5%	130mA/mm ²
DIAMOND	SiO _{0.5} N _{0.6}	(1)	~30 nm	25	±5%	150mA/mm ²
DIAMOND	SiO _{0.5} N _{0.6}	(2)	~30 nm	19	±4%	200mA/mm ²
DIAMOND	SiO _{0.5} N _{0.6}	(3)	~40 nm	35	±4%	120mA/mm ²
DIAMOND	SiO _{0.5} N _{0.6}	(4)	~30 nm	38	±5%	110mA/mm ²